

You must show all work on this quiz for full credit. Good luck!

I. Let  $A$  and  $B$  be events in a sample space  $S$  and  $P$  be a probability function such that  $P(A) = .75$ ,  $P(B) = .81$ , and  $P(A \cup B) = 0.92$ . Please find the following probabilities. You must show at least one intermediate step using the rules of probability to earn full credit. (8 points total)

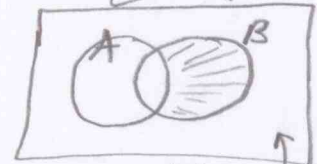
(a)  $P(A \cap B) = P(A) + P(B) - P(A \cup B) = .75 + .81 - .92 = .64$   
(2 points)

(b)  $P(A' \cap B) = P(B) - P(A \cap B) = .81 - .64 = .17$   
(3 points)

OR  $\rightarrow = P(A \cup B) - P(A) = .92 - .75 = .17$

(c)  $P(A' \cap B') = P((A \cup B)') = 1 - P(A \cup B)$   
(3 points)

De Morgan's Law  $= 1 - .92 = .08$



OR  $A \cup B = A \cup (A' \cap B)$

$B = (A' \cap B) \cup (A \cap B)$

II. Two cards are drawn without replacement from a standard 52-card playing deck. What is the probability that the draw will yield an ace and a face card (i.e. a king, queen, or jack)? (4 points)

Number possible outcomes:  
 $52(51)$  if count order,  $\binom{52}{2}$  if do not count order

$\frac{2 \cdot 4 \cdot 12}{52 \cdot 51}$  OR  $\frac{\binom{4}{1} \binom{12}{1}}{\binom{52}{2}} = .0362$

aces faces

III. A fair four-sided die is rolled seven times and the rolls are recorded. An example of an outcome from this random experiment is 1321342. Given the following events and probabilities please find the indicated probabilities below. (4 points each, 8 points total)

Events:

$A$ : Exactly two 3s are in the seven rolls (note that the example outcome above is in this event)

$B$ : Exactly two 2s are in the seven rolls (note that the example outcome above is in this event)

$C$ : There is at least one 3 in the seven rolls (again note that the example outcome above is in this event)

Probabilities:  $P(A) = P(B) = \frac{\binom{7}{2} 3^5}{4^7} = \frac{\binom{7}{2} \left(\frac{1}{4}\right)^2 \left(\frac{3}{4}\right)^5}{4^7}$

(a)  $P(C) = 1 - P(C') = 1 - \frac{3^7}{4^7} = .8665$

$C'$ : no 3s in 7 rolls,  $P(C') = \frac{3^7}{4^7}$

(b)  $P(A \cup B) = P(A) + P(B) - P(A \cap B)$

$A \cap B$ : Exactly 2 3's and 2 2's:  $\underline{3} \underline{3} \underline{2} \underline{2} \underline{\quad} \underline{\quad} \underline{\quad}$

$P(A \cap B) = \frac{\binom{7}{2} \binom{5}{2} 2^4}{4^7}$

So  $\rightarrow P(A \cup B) = \frac{2 \left( \frac{\binom{7}{2} 3^5}{4^7} \right) - \frac{\binom{7}{2} \binom{5}{2} 2^4}{4^7}}{4^7} = .5204$

← Pinc 3's  
← Pinc 2's  
← 4HP  
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